

CLAIMS:

The invention claimed is:

1. A method of polishing a semiconductor substrate, comprising:
polishing a semiconductor substrate using a polishing solution comprising a liquid and a solid;

after said polishing, cleaning a remaining outermost polished surface of the semiconductor substrate with a first cleaning solution and a brush effective to remove at least some of the polishing solution from the outermost polished surface;

after the brush cleaning, at least partially drying the outermost polished surface; and

after the drying, spray cleaning the outermost polished surface with a second cleaning solution.

2. The method of claim 1 wherein the polishing comprises chemical mechanical polishing.

3. The method of claim 1 wherein said at least partially drying comprises completely drying the outermost polished surface.

4. The method of claim 1 wherein the drying comprises exposing the outermost polished surface to subatmospheric pressure.

5. The method of claim 1 wherein the drying comprises raising a temperature of the semiconductor substrate from what ambient temperature was during the polishing.

6. The method of claim 5 wherein said at least partially drying comprises completely drying the outermost polished surface.

7. The method of claim 5 wherein the raised temperature is also higher than an ambient temperature during the spray cleaning.

8. The method of claim 5 wherein said at least partially drying comprises completely drying the outermost polished surface, and the raised temperature is also higher than an ambient temperature during the spray cleaning.

9. The method of claim 5 wherein the drying comprises exposing the outermost polished surface to subatmospheric pressure.

10. The method of claim 5 wherein the drying comprises exposing the outermost polished surface to infrared heating lamps.

11. The method of claim 5 wherein the drying comprises exposing the outermost polished surface to infrared heating lamps at atmospheric pressure.

12. The method of claim 5 wherein the drying comprises exposing the outermost polished surface to a plasma.

13. The method of claim 12 wherein the plasma exposing comprises a temperature of at least 100°C and no greater than 100 Torr pressure.

14. The method of claim 12 wherein the plasma comprises nitrogen and hydrogen.

15. The method of claim 14 wherein the nitrogen and hydrogen are derived from a gas comprising NH_3 .

16. The method of claim 14 wherein the nitrogen and hydrogen are derived from H_2 and N_2 .

17. The method of claim 1 being void of any fluid spraying onto the outermost polished surface intermediate said polishing and said cleaning with the brush and first cleaning solution.

18. The method of claim 1 being void of any fluid spraying onto the outermost polished surface intermediate said cleaning with the brush and first cleaning solution and the drying.

19. The method of claim 1 being void of any fluid spraying onto the outermost polished surface intermediate said polishing and said cleaning with the brush and first cleaning solution, and being void of any fluid spraying onto the outermost polished surface intermediate said cleaning with the brush and first cleaning solution and the drying.

20. The method of claim 1 wherein the drying is effective to reduce remaining particulate contamination on the outermost polished surface after the spray cleaning than would otherwise occur in the absence of the drying.

wherein

21. The method of claim 1 [^]the polishing occurs with a polishing pad that leaves material of the pad on the substrate, the drying being effective to substantially dehydrate and reduce size of said material of the pad on the substrate.

22. The method of claim 1 wherein the first and second cleaning solutions are common in composition.

23. The method of claim 1 wherein the first and second cleaning solutions are different in composition.

24. A post-CMP cleaning process comprising brush cleaning a CMPed surface, followed by at least partially drying the CMPed surface, followed by spray cleaning the CMPed surface.

25. The method of claim 24 wherein said at least partially drying comprises completely drying the CMPed surface.

26. The method of claim 24 wherein the drying comprises exposing the CMPed surface to subatmospheric pressure.

27. The method of claim 24 wherein a substrate is chemical mechanical polished, the drying comprises raising a temperature of the substrate from what ambient temperature was during the chemical mechanical polishing.

28. The method of claim 27 wherein said at least partially drying comprises completely drying the CMPed surface.

29. The method of claim 27 wherein the raised temperature is also higher than an ambient temperature during the spray cleaning.

30. The method of claim 27 wherein said at least partially drying comprises completely drying the outermost polished surface, and the raised temperature is also higher than an ambient temperature during the spray cleaning.

31. The method of claim 27 wherein the drying comprises exposing the CMPed surface to subatmospheric pressure.

32. The method of claim 27 wherein the drying comprises exposing the CMPed surface to infrared heating lamps.

33. The method of claim 27 wherein the drying comprises exposing the CMPed surface to infrared heating lamps at atmospheric pressure.

34. The method of claim 27 wherein the drying comprises exposing the CMPed surface to a plasma.

35. The method of claim 34 wherein the plasma comprises nitrogen and hydrogen.

36. The method of claim 34 wherein the plasma exposing comprises a temperature of at least 100°C and no greater than 100 Torr pressure.

37. The method of claim 24 being void of any fluid spraying onto the CMPed surface intermediate chemical mechanical polishing and the brush cleaning.

38. The method of claim 24 being void of any fluid spraying onto the CMPed surface intermediate the brush cleaning and the drying.

39. The method of claim 24 being void of any fluid spraying onto the CMPed surface intermediate chemical mechanical polishing and the brush cleaning, and being void of any fluid spraying onto the CMPed surface intermediate the brush cleaning and the drying.

40. The method of claim 24 wherein the drying is effective to reduce remaining particulate contamination on the CMPed surface after the spray cleaning than would otherwise occur in the absence of the drying.

41. The method of claim 24 wherein a polishing pad is utilized during CMP, the CMP with the polishing pad leaving material of the pad on the CMPed surface, the drying being effective to substantially dehydrate and reduce size of said material of the pad on the substrate.

42. A method of processing a semiconductor substrate, comprising:

- forming a dielectric layer over a semiconductor substrate;
- forming contact openings into the dielectric layer and alignment registration markings into the dielectric layer using a common masking step and at least one common etching step;
- forming a conductive material over the dielectric layer to within the contact openings and to within the registration markings;
- polishing through the conductive material to the dielectric layer using a polishing solution comprising a liquid and a solid;
- after said polishing, cleaning a remaining outermost polished surface of the semiconductor substrate with a first cleaning solution and a brush effective to remove at least some of the polishing solution from the outermost polished surface;
- after the brush cleaning, at least partially drying the outermost polished surface; and
- after the drying, spray cleaning the outermost polished surface with a second cleaning solution.

43. The method of claim 42 wherein the polishing comprises chemical mechanical polishing.

44. The method of claim 42 wherein said at least partially drying comprises completely drying the outermost polished surface.

45. The method of claim 42 wherein the drying comprises exposing the outermost polished surface to subatmospheric pressure.

46. The method of claim 42 wherein the drying comprises raising a temperature of the semiconductor substrate from what ambient temperature was during the polishing.

47. The method of claim 46 wherein said at least partially drying comprises completely drying the outermost polished surface.

48. The method of claim 46 wherein the raised temperature is also higher than an ambient temperature during the spray cleaning.

49. The method of claim 46 wherein said at least partially drying comprises completely drying the outermost polished surface, and the raised temperature is also higher than an ambient temperature during the spray cleaning.

50. The method of claim 46 wherein the drying comprises exposing the outermost polished surface to subatmospheric pressure.

51. The method of claim 46 wherein the drying comprises exposing the outermost polished surface to infrared heating lamps.

52. The method of claim 46 wherein the drying comprises exposing the outermost polished surface to infrared heating lamps at atmospheric pressure.

53. The method of claim 46 wherein the drying comprises exposing the outermost polished surface to a plasma.

54. The method of claim 53 wherein the plasma comprises nitrogen and hydrogen.

55. The method of claim 53 wherein the plasma exposing comprises a temperature of at least 100°C and no greater than 100 Torr pressure.

56. The method of claim 42 being void of any fluid spraying onto the outermost polished surface intermediate said polishing and said cleaning with the brush and first cleaning solution.

57. The method of claim 42 being void of any fluid spraying onto the outermost polished surface intermediate said cleaning with the brush and first cleaning solution and the drying.

58. The method of claim 42 being void of any fluid spraying onto the outermost polished surface intermediate said polishing and said cleaning with the brush and first cleaning solution, and being void of any fluid spraying onto the outermost polished surface intermediate said cleaning with the brush and first cleaning solution and the drying.

59. The method of claim 42 wherein the drying is effective to reduce remaining particulate contamination on the outermost polished surface after the spray cleaning than would otherwise occur in the absence of the drying.

60. The method of claim 42 wherein the polishing occurs with a polishing pad that leaves material of the pad on the substrate, the drying being effective to substantially dehydrate and reduce size of said material of the pad on the substrate.

61. The method of claim 42 wherein the conductive material comprises tungsten.

62. A method of cleaning residue from registration alignment markings formed on a semiconductor substrate comprising polishing a material within which the registration alignment markings are received with a polishing solution comprising a liquid and a solid, followed by brush cleaning a remaining outermost polished surface, followed by at least partially drying the polished surface, followed by spray cleaning the outermost polished surface.

63. The method of claim 62 wherein the polishing comprises chemical mechanical polishing.

64. The method of claim 62 wherein said at least partially drying comprises completely drying the outermost polished surface.

65. The method of claim 62 wherein the drying comprises exposing the outermost polished surface to subatmospheric pressure.

66. The method of claim 62 wherein the drying comprises raising a temperature of the semiconductor substrate from what ambient temperature was during the polishing.

67. The method of claim 66 wherein said at least partially drying comprises completely drying the outermost polished surface.

68. The method of claim 66 wherein the raised temperature is also higher than an ambient temperature during the spray cleaning.

69. The method of claim 66 wherein said at least partially drying comprises completely drying the outermost polished surface, and the raised temperature is also higher than an ambient temperature during the spray cleaning.

70. The method of claim 66 wherein the drying comprises exposing the outermost polished surface to subatmospheric pressure.

71. The method of claim 66 wherein the drying comprises exposing the outermost polished surface to infrared heating lamps.

72. The method of claim 66 wherein the drying comprises exposing the outermost polished surface to infrared heating lamps at atmospheric pressure.

73. The method of claim 66 wherein the drying comprises exposing the outermost polished surface to a plasma.

74. The method of claim 73 wherein the plasma comprises nitrogen and hydrogen.

75. The method of claim 73 wherein the plasma exposing comprises a temperature of at least 100°C and no greater than 100 Torr pressure.

76. The method of claim 62 being void of any fluid spraying onto the outermost polished surface intermediate said polishing and said brush cleaning.

77. The method of claim 62 being void of any fluid spraying onto the outermost polished surface intermediate said brush cleaning and the drying.

78. The method of claim 62 being void of any fluid spraying onto the outermost polished surface intermediate said polishing and said brush cleaning, and being void of any fluid spraying onto the outermost polished surface intermediate said brush cleaning and the drying.

79. The method of claim 62 wherein the drying is effective to reduce remaining particulate contamination on the outermost polished surface after the spray cleaning than would otherwise occur in the absence of the drying.

80. The method of claim 62 wherein the polishing occurs with a polishing pad that leaves material of the pad on the substrate, the drying being effective to substantially dehydrate and reduce size of said material of the pad on the substrate.